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CULTURE OF PENAEID SHRIMP IN BRACKISH-WATER PONDS, 1966-67[1]

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ABSTRACT

Young shrimp have shown rapid growth in brackish-water ponds which had been fertilized, but to which no supplemental feed was added. In 1966, white shrimp *(Penaeus setiferus)* were stocked at the rate of nine shrimp per square meter of bottom in a pond that had been fertilized with chicken manure. In 1967, brown shrimp *(P. a. aztecus)* were stocked at a rate of 22 shrimp per square meter of bottom in one pond that was fertilized with rice husks and in another that was not fertilized. In both experiments initial growth was rapid; the shrimp attained bait size (75 to 93 mm total length) in 5 to 7 weeks. This rapid growth was followed by a period of slow growth. In 1967, supplementary feeding produced additional gains after growth had nearly ceased.

Survival of the white shrimp was 84 percent, whereas survival of the brown shrimp was 23 percent in the untreated pond and 31 percent in the fertilized pond. Oxygen deficiencies caused by dense blooms of phytoplankton during the 1967 experiment resulted in serveral mass mortalities.

INTRODUCTION

Experimental rearing of penaeid shrimp continued in 1966-67 at the Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas. Our investigations are

[1]Contribution No. 278 from the Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas.

directed toward developing procedures which will lead to commercial production of shrimp in brackish-water enclosures. The major objectives of the project are: (1) to determine the factors upon which shrimp growth depends; (2) to learn how to manipulate these factors for vigorous shrimp growth; and (3) to determine which species of shrimp are best adapted to pond culture.

GENERAL PROCEDURES

In preparation for an experiment, the 1/8 acre ponds (Fig. 1) are pumped dry; within 3 days they refill with brackish ground water which seeps in through the porous sand substrate. As no other water is allowed to enter (except as noted for the 1967 experiment), the risk of introducing objectionable fish or other marine organisms is minimized.

The postlarval shrimp used to stock the ponds were reared from eggs spawned in the laboratory by the method described by Cook and Murphy (1966).

To determine growth during the experiment, 40 shrimp were seined from each pond weekly, weighed after surface moisture was removed with absorbent paper tissue, measured, and returned to the ponds.

Figure 1. Brackish-water ponds (1/8-acre) used in shrimp rearing experiments.

1966 EXPERIMENT

In 1966, a pond was emptied on May 10, refilled, and then left undisturbed for 57 days to allow time for a natural population of planktonic and benthic organisms to become established. On July 6, the water was fertilized with 1 cubic yard of chicken manure which was deposited in a pile toward the shallow end of the pond. Similar amounts were added on August 24 and September 8. The shrimp in this pond received no supplemental food.

On July 14, 4,092 postlarval white shrimp, *Penaeus setiferus* (Linnaeus), averaging 12.3 mm total length and 0.012 g in weight (37,800 shrimp per pound) were stocked.

During the initial 5 weeks, the shrimp grew rapidly. Over the next 4 weeks, however, the rate of growth gradually decreased. Through the remaining 8 weeks of the study, shrimp growth was negligible (Table 1 and Fig. 2).

A total of 3,439 shrimp weighing 73.5 pounds was harvested on November 10, giving an estimated yield of 588 pounds of whole shrimp, or 381 pounds of tails, per acre. The population at the time of harvest was one shrimp per 1.5 square feet of bottom surface. Survival during the 120-day period was 84 percent.

Although the white shrimp produced in this study were small, their market value for canning at the time of harvest was about 44 cents per pound (tail weight). On the basis of this price, the shrimp produced in the pond had a market value of $167.64 per acre. An even more profitable outlet for pond-reared shrimp of this size is the livebait market. Bait dealers in Texas and Florida retail live shrimp for a minimum of $2.00 per quart—approximately 1½ pounds of heads-on shrimp (Inglis and Chin, revised by Baxter, 1966). As bait, the crop harvested would thus yield $784.00 per acre. The shrimp attained bait size in about 5 weeks and even at the quantities produced in our experimental pond, pond-rearing of bait shrimp probably could be economically feasible, particularly since it may be possible to produce more than one crop in a single year.

TABLE 1

Lengths and weights of white shrimp held in a brackish-water pond, 1966.

Date	*Length (mm)*		*Weight (g)*		*Number of whole shrimp per pound*
	Average	*Daily increment during period*	*Average*	*Daily increment during period*	
July 14	12.3	--	0.012	--	37,800
August 18	92.9	2.30	5.8	0.17	79
September 15	108.2	0.55	8.5	0.10	53
November 10	113.5	0.09	9.7	0.02	47

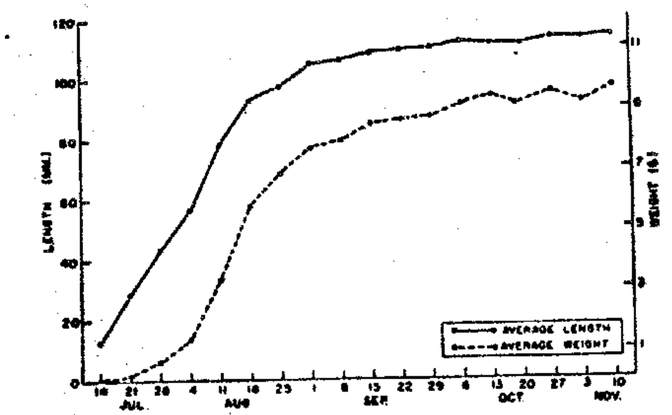

Figure 2. Growth of white shrimp over a 4-month period in 1966.

1967 EXPERIMENT

In 1967, two ponds were drained on January 10. On January 16, 450 pounds of rice husks were added to one pond to fertilize the water and increase the surface area of the substrate for greater growth of micro-organisms. The husks floated, blanketing the pond's surface, but sank after 8 days. The other pond was untreated. The ponds were undisturbed until each was stocked on April 28 with 9,000 postlarval brown shrimp, *P. a. aztecus* Ives, which averaged 6.5 mm in length and 0.0008 g in weight, or about 567,000 shrimp per pound.

As in 1966, the growth of shrimp in both ponds was initially rapid followed by a period of slow growth. After the rate of growth had declined, Purina[2] rabbit chow

[2]Trade names referred to in this publication do not imply endorsement of commercial products.

was fed to shrimp in each of the ponds at the rate of 5 percent of the average body weight of the estimated total population per day. Food was distributed by hand once a day over the entire pond. Feeding was begun on August 4 in the fertilized pond and on August 31 in the untreated pond. Growth increased after supplemental feeding was begun. Detailed growth data for these experiments are presented in Table 2 and 3, and Figure 3.

A total of 2,065 shrimp weighing 24 pounds was harvested from the untreated pond. The estimated yield per acre was 192.4 pounds of whole shrimp, or 119.3 pounds of tails. Survival was 22.9 percent. In the fertilized pond, 2,753 shrimp weighing 56.4 pounds survived to produce an estimated yield of 451 pounds of whole shrimp or 280 pounds of tails per acre. Survival was 30.6 percent.

TABLE 2

Lengths and weights of brown shrimp held in a fertilized, brackish-water pond, 1967.

	Lenght (mm)		*Weight (g)*		
Date	*Average*	*Daily increment during period*	*Average*	*Daily increment during period*	*Number of whole shrimp per pound*
April 28	6.5	--	0.0008	--	567,500
May 18	26.0	0.98	0.16	0.008	2,838
June 15	75.7	1.78	3.6	0.12	126
July 13	86.1	0.37	4.9	0.05	93
August 17	91.8	0.16	6.1	0.03	74
September 19	103.7	0.36	9.3	0.10	49

TABLE 3

Lengths and weights of brown shrimp held in an untreated, brackish-water pond, 1967.

	Length (mm)		*Weight (g)*		
Date	*Average*	*Daily increment during period*	*Average*	*Daily increment during period*	*Number of whole shrimp per pound*
April 28	6.5	--	0.0008	--	567,500
May 18	29.3	1.14	0.24	0.012	1,892
June 15	79.9	1.81	4.0	0.13	114
July 13	87.0	0.25	5.0	0.04	91
August 17	80.8	-0.18	3.9	-0.03	116
September 19	88.6	0.24	5.3	0.04	86

PRACTICAL IMPLICATIONS

This work was done to determine if the application of fertilizer to a pond would induce the growth of phytoplankton, which would in turn support the growth of organisms upon which shrimp feed. The initial rapid growth of young shrimp in these experiments, as well as in my previous study (Wheeler, 1967), is attributed primarily to an abundant food supply which grew while the ponds lay fallow. I assume that as soon as those organisms used as food by the shrimp were depleted, shrimp growth declined.

It is difficult to assess the value of fertilization. In 1967 the initial growth of brown shrimp in the fertilized pond was slower than that of either the brown shrimp

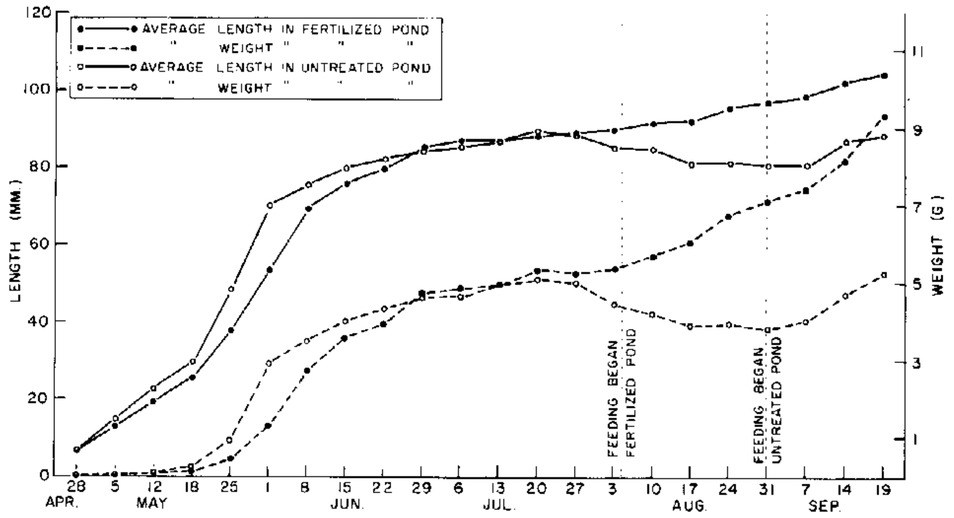

Figure 3. Growth of brown shrimp in two ponds over a 145-day period in 1967.

in the unfertilized pond or the white shrimp which were reared in 1966. It was 9 weeks before the size of brown shrimp in the fertilized pond equalled that in the unfertilized pond.

Despite an apparent shortage of food during the latter part of the 1966 experiment, the high survival of shrimp suggests that cannibalism and disease were not major problems. Poor survival of shrimp in 1967 is attributed to oxygen depletion rather than cannibalism or disease. The levees surrounding our ponds obstruct the wind and prevent the water from being fully aerated by wind circulation. On several occasions in 1967 when the phytoplankton was dense, oxygen became depleted in the ponds (less than 0.5 ppm during the early morning) causing distress and mortality among the shrimp. On three occasions low concentrations of oxygen in the fertilized pond were raised by flushing and by increasing water circulation with a pump which delivers about 56 gallons per minute. After this treatment, shrimp which had been swimming erratically resumed their normal behavior and mortalities ceased. All water that was introduced was filtered through crushed oyster shell to prevent the entry of undesirable species into the pond.

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